

IN THE APPLICATION
OF
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FOR A
HYDRANT KNOCK-OFF COMBINATION FLOW STOP
AND BACKFLOW CHECK VALVE

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HYDRANT KNOCK-OFF COMBINATION FLOW STOP
AND BACKFLOW CHECK VALVE

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

The present invention relates to valves. More particularly, the present invention relates to valves useful with hydrants such as fire hydrants which prevent water loss, in case of accidental breaking away of the hydrant, and backflow into the water system.

2. DESCRIPTION OF THE RELATED ART

Hydrants such as fire hydrants are particularly susceptible to being broken away from their water supply system due to vehicle collisions due to their proximity to city streets as commonly installed. Upon the hydrant breaking away, a large flow of water would be released from the water system if left unchecked. In a wet barrel hydrant, useful in mild

climates, the hydrant is kept at water system pressure. It is known to provide a breakaway connection with a water system riser such as a breakaway flange ring or a breakaway riser, allowing the hydrant to break away from the water system riser upon collision, thus minimizing the overall damage to the water system. It is also known to provide valves, such as flap valves between the breakaway flange or breakaway riser and the water system riser which stop the uncontrolled flow of water from the system upon collision. In some cases, backflow from the hydrant or broken off flange or breakaway riser can take place, allowing contaminated water to enter the water supply system. It would be desirable to provide a valve which is simple in design and mountable between a water system riser and a hydrant having a breakaway flange ring or riser, the valve acting as a stop valve to prevent uncontrolled flow of system water from the broken hydrant system while acting as a check valve to prevent backflow of contaminated water into the water system riser.

U.S. Patent Publication No. 2003/0150486 A1, published August 14, 2003, for Liebert, describes a breakaway safety shut-off valve for use with a tank for flammable liquids or dangerous chemicals having an upwardly spring-biased ball which is separated from a shutoff seat by arm segments to maintain

the ball valve in an open position during normal use of the safety valve. Upon the breaking away of the safety valve at a weakened break-off point such as by accident or sabotage, the arm segments disengage an annular shoulder, allowing the spring-biased ball to shut against the seat, thereby closing the broken valve.

U.S. Patent No. 22,927, issued February 15, 1859, to Bartholomew, describes a hydrant with a lower ball valve in a curved standpipe.

U.S. Patent No. 208,072, issued September 17, 1878, describes a hydrant having a ball valve W.

U.S. Patent No. 349,230, issued September 14, 1886, to Mead, describes a hydrant having a supplemental twist-open valve for allowing system water to enter a hydrant from a riser.

U.S. Patent No. 4,127,142, issued November 28, 1978, to Snider, describes a flap type check valve connected between a riser pipe and wet barrel hydrant, the connection with the hydrant being a breakaway flange connection. Upon rupture of a breakaway flange connection, the check valve is allowed to close, stopping uncontrolled flow of water from the broken hydrant system.

U.S. Patent No. 5,941,268, issued August 24, 1999, to Ross, Jr., describes a knock-off tank safety valve employing a spring-loaded mushroom valve which closes when the safety valve is broken away.

5 European Patent No. EP1010824, published June 21, 2000, describes a hydrant having a bulbous ball check valve located between the hydrant and a riser pipe having a vertically traveling ball guided by guide rods between upper and lower seats.

10 None of the above inventions and patents, taken either singly or in combination, is seen to describe the instant invention as claimed. Thus, a hydrant knock-off flow stop valve solving the aforementioned problems is desired.

15 **SUMMARY OF THE INVENTION**

The present invention is a valve which is mountable between a water system riser and a hydrant having a breakaway flange ring or riser, the valve acting as a stop valve to
20 prevents uncontrolled flow of system water from the broken hydrant system while acting as a check valve to prevent backflow of contaminated water into the water system riser. The vertically oriented valve body is in the shape of a bulbous

cylinder having an upper flange for connection with the lower flange of a wet-type hydrant by means of a break ring. The valve has a lower flange for connection with a water system riser pipe. One embodiment of the invention features radial vanes spaced around the interior of the bulbous valve wall, the vanes defining a central cylinder coaxial with the valve and acting as guides for a movable valve element to travel vertically up and down.

The lower flange defines an inner seat which acts as a check valve with the valve element when engaged, preventing backflow of contaminated water into the riser of the water system. The valve element is lifted upward with flow of water through the valve and into the open hydrant, and its travel is stopped by a restraining cage extending downward from the upper valve flange. The restraining cage has a lower seat connected with an upper ring by spaced legs. The restraining cage is held by the upper ring in the upper valve flange by the lower flange of the hydrant as connected by the break ring. Upon the break ring being sheared or ruptured, the hydrant flange pulls away, allowing the restraining cage to lift off and away from the upper valve flange, thereby allowing the force of water flow to raise the valve element to engage an upper circumferential seal directly beneath the upper flange on the

interior of the bulbous valve wall, thus acting as a flow stop valve.

During normal operation of the hydrant, such as providing water to a fire hose, water flows upward from a riser, between the spaced vanes, through the legs of the restraining cage, and upward through the upper flange and into the hydrant. The preferred movable valve element is a ball or globe, preferably of hollow cast iron and having a soft plastic coating.

An alternative embodiment substitutes a double ended, mushroom type movable valve element which has an upper mushroom shape element for engaging the upper seal for water stop flow and a lower, inverted mushroom shape element for engaging the lower seal acting as a check valve. The stems of the mushroom elements extend toward a central plate along a common axial support upon which they are slidably mounted, coil springs providing separation force such that during normal operation water pressure lifts the lower mushroom element while the upper mushroom element is restrained from upward travel by the restraining cage. Any backflow is checked by the lower mushroom element engaging the lower seal.

Another embodiment provides a double ended, mushroom type valve element which is held between mushroom stems by a spider structure having a hub supporting the axial support and

radially spaced spokes extending to an outer ring held at about the elevational center of the valve. The outer ring may be held between half-grooves of connecting flanges of a split case flange connection. This embodiment operates similarly to the vane guided free double mushroom valve element described above.

The invention provides improved elements and arrangements thereof for the functions described which are inexpensive, dependable and fully effective in accomplishing its intended purposes.

The novel and important aspects of the present invention will become readily apparent upon further review of the following specification and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1A is an elevation view of a wet hydrant connected with a knock-off flow stop valve according to the present invention.

Fig. 1B is a plan view of the wet hydrant of Fig. 1A.

Fig. 2 is a partially broken away elevation view of an existing knock-off wet hydrant as attached by a break ring to a water system riser pipe by means of a flange section.

Fig. 3 is a partial section view taken along line 3-3 of Fig. 1A.

Fig. 4 is a partial section view taken along line 4-4 of Fig. 1B.

5 Fig. 5 is a section view as in Fig. 3 with the ball valve shut-off element in a steady state and backflow check position.

Fig. 6 is a partially exploded section view as in Fig. 3 with the ball valve element in a stop flow position.

10 Fig. 7 is a section view of another embodiment similar to that of Fig. 3 having mushroom type valve elements.

Fig. 8 is a partial exploded view of the upper mushroom type valve element and support of Fig. 7.

15 Fig. 9A is a section view similar to that of Fig. 6 with the mushroom type valve elements in steady state and backflow check position.

Fig. 9B is a partial exploded section view similar to that of Fig. 6 with the mushroom type valve elements in a stop flow position.

20 Fig. 10 is a section view similar to that of Fig. 6 with only an upper stop flow valve element in steady state position.

Fig. 11 is a section view similar to that of Fig. 6 with only a lower valve element which is shown in a flow position.

Fig. 12 is a section view of another embodiment similar to that of Fig. 6 shown in a flow position.

Fig. 13 is a section view of another embodiment similar to that of Fig. 2 shown in a flow position.

5 Similar reference characters denote corresponding features consistently throughout the attached drawings.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

10 The present invention is a valve which is simple in design and mountable between a water system riser and a hydrant having a breakaway flange ring or riser, the valve acting as a stop flow valve to prevent uncontrolled flow of system water from the broken hydrant system while acting as a check valve to
15 prevent backflow of contaminated water into the water system riser.

Referring to Figs. 1A, 1B, and 2, there is shown a wet hydrant combination flow stop and backflow check valve system
20 10. System 10 includes a wet hydrant H, i.e., a hydrant filled with water under unused conditions, having a lower flange F for connection with a conventional city water supply system (not shown). System 10 includes a bulbous, cylindrical valve 12 having an upper flange 14 for connection with flange F by a

shear break ring **S** and breakaway bolts **B**, upper flange **14** having a recess **16** receiving the lower edge of shear break ring **S** for mounting hydrant **H** to valve **12**. Valve **12** has a lower flange **18** for connection to a water system riser **R** (see Fig. 2). Fig. 2 shows a partially broken away, environmental elevation view of a known breakaway wet hydrant system where hydrant **H** is attached to flange section **FS** by a shear break ring **S** by bolts **B** through bores **R** (see Fig. 1B). Flange section **FS** is, in turn, attached to riser **R** from a water system at mating flanges held by bolts **B**. Flange section **FS** has circumferential hydrant and riser flange gaskets **HG** and **RG**, respectively, for sealing against leaks in a known manner. In a preferred embodiment, valve **12** is similarly configured to flange section **FS** so as to be substituted therefor in the hydrant system **10**. For the interests of clarity, flange gaskets or seals corresponding to gaskets **HG** and **RG** and the riser **R** are not shown in the Figures illustrating the installation of the inventive valve **12**, but would ordinarily be included in the actual installation.

Referring to Figs. 3-6, there are shown sectional views of a first embodiment of the inventive valve in a normal flow configuration, a rotated normal flow configuration, a backflow check position, and a partially exploded flow stop position,

respectively. Valve 12 has a body having a vertically oriented, generally cylindrical, bulbous, outer wall 20 having an upper flange 14 which defines a flange recess 16 for connection with a hydrant flange F by means of a shear break ring S and bolts B through receiving bores R (See Fig. 2). All embodiments of the inventive valve employ the hydrant connection and riser pipe or similar water system element as shown in Fig. 2 and are not shown or described in the remaining drawings. Outer wall 20 forms a circumferential upper valve seat 22 at its upper neck. The lower end of outer wall 20 mates with a circumferential lower valve seat ring 24 forming a lower valve seat 26 and held in place by the riser flange (see Fig. 2).

Vanes 28 extend radially inward from the bulbous portion of outer wall 20 and extend vertically so as to form a cylindrical vertical valve member guide defined by vertical vane valve guides 30. There are preferably four vanes 28 in valve 12, but three or more vanes may be provided as desired. The water may flow around ball valve element 32 and between vanes 28 in the bulbous portion of the valve 12 when the ball valve element is in a position between upper valve seat 22 and lower valve seat 26.

The ball valve element **32** is more dense than water so as to naturally sink under static water conditions. As shown in Fig. 3, the ball valve element **32** is preferably a hollow globe having an outer covering **33** of relatively soft plastic or polymeric material to enhance sealing against seats **22** or **26**. Other Figures show ball valve element **32** as solid metal or plastic. A valve ball restraining cage **34** is located in the upper portion of valve **12** having a centrally located concave ball seat **36** having a surface shaped to conform to the ball valve element **32** so as to restrain ball **32** during upward water flow to hydrant **H** during use. Cage **34** preferably has at least three cage legs **38** radiating upwardly and outwardly, joining with a circumferential cage retaining ring **40** which fits into an upward opening cage retaining ring groove **42** in the upper, inner side of valve upper flange **14**. Cage **34** is held in place in groove **42** by flange **F** when hydrant **H** is in place. Cage legs **38** extend upward and outward, extending along the inner wall of upper flange **42** as it flares upward and outward, thereby partially supporting cage legs **38**. Legs **38** space cage ball seat **36** and, thereby, ball valve element **32** from upper seat **22**, thus, allowing flow of water upward between vanes **28** and through cage legs **38** to the hydrant **H** when water is supplied to hydrant **H**.

As illustrated in Fig. 6, upon the removal of hydrant flange **F**, such as during an auto accident, shear break ring **S** is shattered, leaving stored water pressure to drive the now freed cage **34** upwards and away from valve **12**, ball valve element **32** (shown here as a solid material) being driven by the force of water. The ball valve element is guided by the vanes **30** upward until valve ball element **32** seals against circumferential upper valve seat **22**, thus stopping water flow outward from the valve and the water supply system. When the hydrant is not being used as a water supply, ball valve element **32** descends to rest against seat **26**. Also, ball valve element **32** is guided by vanes **28** and forced down against seat **26** when a water backpressure event occurs, thus acting as a check valve to avoid flow of contaminated water to the water system (see Fig. 5).

Referring to Figs. 7-10, there are shown sectional views of another embodiment of the present invention, wherein the valve element is a double ended, spring-loaded, double mushroom shaped valve element supported axially by a support spider attached at the outer wall of the bulbous shaped wall. As seen in Fig. 7, valve **112** has a vertically oriented, generally cylindrical, bulbous outer wall **120** having an upper flange **114** defining a flange recess **116** for connection with hydrant flange

F by means of a shear break ring **S** and bolts **B** through receiving bores **R** (see Fig. 2). Outer wall **120** forms a circumferential upper valve seat **122** at its upper neck. The lower end of outer wall **120** mates with a circumferential lower valve set ring **124** forming a lower valve seat **126** and held in place by the upper flange of riser **R** (see Fig. 2).

Outer wall **20** is radially split at its midsection, forming an upper generally hemispheric outer wall **144** having an outer wall lower flange **146**. Lower flange **146** defines flange bores **148** for attachment to lower generally hemispheric outer wall **150** at lower hemispheric outer wall lower flange **152**. Lower flange **152** has flange bores **154**, the outer wall flange bores being aligned and secured by flange securing bolts **156** and securing nuts **158**. A mushroom valve-restraining cage **134**, similar or identical to that of the first embodiment (element no. **34**), is located in the upper portion of valve **112**. Restraining cage **134** is formed by a centrally located concave seat **206** having a surface shaped to conform to the upper hemispheric mushroom valve member **176** of mushroom valve **170** so as to restrain mushroom valve **170** from moving upward under coil spring force and during upward water flow to hydrant **H** during use.

Cage **134** preferably has at least three cage legs **208** radiating upwardly and outwardly, joining with a circumferential cage retaining ring **210** which fits into an upward opening cage retaining ring groove **142** in the upper, inner side of valve upper flange **114**. Cage **134** is held in place in groove **142** by flange **F** when hydrant **H** is in place. Cage legs **208** space cage mushroom seat **136** and, thereby upper mushroom valve element **176** from upper seat **122**, thus, allowing flow of water upward around mushroom valve element **170** and between the cage legs **208** to the hydrant **H** when water is supplied to hydrant **H** for supplying, for example, a fire hose. As illustrated in Fig. 9B, upon the removal of hydrant flange **F**, such as during an auto accident, shear break ring **S** is shattered, leaving stored water pressure to drive the now freed cage **134** upwards and away from valve **112**, mushroom valve element **170** being driven by the force of the water and the coiled spring **184** (See description below).

A support spider **160** supports mushroom valve element **170** by support spider hub **164**. Support spider hub **164** is connected to support spider outer rim **162** by support spider spokes **166** (See Fig. 8). Support spider outer rim **162** is held horizontal in the interior of valve **112** by corresponding inner half grooves at the intersection of outer wall flanges **146** and **152**

at the split between upper hemispheric outer wall **144** and lower hemispheric outer wall **150**. A vertical, axial support shaft **168** is supported by support spider hub **164** so as to form an upper portion **169** and a support shaft lower portion **186** of equal lengths. Upper hemispheric mushroom valve member **176** is centrally supported by an upper axial support shaft cylinder stem or engaging portion **172** integral with the hemispheric portion of mushroom valve member **176** and includes an axial recess **174** extending its substantial length for slidably receiving the vertical axial support shaft **168**. As shown in Fig. 7, a relatively soft, plastic layer **177** may be installed to cover the upper surface of upper mushroom valve member **175** to provide a tight seal with upper valve seat **122**.

An upper closure coil spring **184** surrounds and is coaxial with upper axial support shaft cylindrical engaging portion or stem **172** and remains in a compressed state between the upper, inner end **178** of engaging portion **172** and the upper side of support spider hub **164**, the lower end **180** of engaging portion **172** being even with or spaced above support spider hub **164**.

Vertical, axial support shaft **168**, as supported by support spider hub **164**, forms a lower portion **186**. Lower mushroom valve element **188** is in the general form of an inverted mushroom having a lower mushroom valve member **194** and a

centrally disposed lower axial support shaft cylindrical engaging portion or stem **190** extending upward therefrom and slidably engaged with support shaft lower portion **186** within axial recess **192**. The lower mushroom valve member may have a soft plastic valve sealing layer **196** (as seen in Fig. 7) on its lower sealing surface for engaging lower circumferential valve seat **126** located on the upper inner side of lower valve seat ring **124**.

Lower closure coil spring **204** surrounds and extends the length of the engaging portion lower inner end **198** and the lower side of support spider hub **164**, coil spring **206** being in a partially compressed condition (See Fig. 7). The upper end **200** of lower engaging portion **190** is even with or spaced below the lower surface of support spider hub **164**. Coil spring **204** urges lower mushroom valve element **188** downward against lower seal **126** (see Fig. 9A) when no water is flowing from hydrant **H**, but opens with the force of system water pressure to the configuration of Fig. 7. Also, lower mushroom valve **188** closes under a backpressure condition, preventing backflow into the riser **R** and into the water system, thus, avoiding contamination of system water.

As illustrated in Fig. 9B, upon the removal of hydrant flange **F**, such as during an auto accident, shear break ring **S**

is shattered, leaving stored water pressure to drive the now freed cage **134** upwards and away from valve **112**, upper mushroom valve **170** being driven by the force of the water and upper coil spring **184**. The upper mushroom valve is guided upwards by upper support shaft portion **169** until it seals against upper valve seat **122**, thus, stopping water flow outward from the valve and the water supply system. When the hydrant **H** is not being used as a water supply, lower mushroom valve element **188** is forced down against seat **126** by pressure from the coil spring **204** and guided by support shaft lower portion **186** within axial recess **192**. Backpressure also allows the closure of valve **188**, thus preventing backflow of contaminated water into the system water supply through riser **R**.

Referring to Fig. 10, there is shown a sectional view of a flow stop valve identical to that of Fig. 7 described above, however, all structure related to the lower mushroom check valve is deleted. In this version of the embodiment of Fig. 7, the valve **112** has only the stop flow capability associated with the knocking off of hydrant **H**, the removal by water flow pressure of cage **134**, and the sealing of mushroom valve **170** against circumferential upper valve seat **122**, thus, stopping system water loss.

Referring to Fig. 11, there is shown a sectional view of a backflow check valve identical to that of Fig. 7 described above, however, all structure related to the upper mushroom flow stop valve is deleted. In this version of the embodiment of Fig. 7, the valve **112** has only the backflow check capability associated with a water backpressure event in which the sealing of mushroom valve **194** against lower seat **126** is accomplished under spring pressure as urged by coil spring **204**.

Referring to Figs. 12 and 13, there is shown a section view of another embodiment of the present invention wherein an elongated version of the valve outer wall and vanes is provided with a double mushroom type valve element which is free to travel in the cylindrical space defined by the vanes. More particularly, vane guided mushroom valve shutoff system **220** has an oblong cylindrical bulbous outer wall **222** having an upper flange **14** having a flange recess **16** (See Fig. 1) for connection with a hydrant flange **F** as previously discussed above. The lower end of outer wall **222** mates with a circumferential lower valve seat ring **124**, forming a lower valve seat **126**. Vanes **228** extend radially inward from the bulbous portion of outer wall **222** and extend vertically so as to form a cylindrical vertical valve member guide defined by vertical vane valve guides **230**. There are preferably four vanes **228** in valve **220**, but three or

more vanes may be provided as desired. The bulbous shape of the outer wall provides passageways for water flow between vanes 228.

The upper mushroom valve element 170 is identical to that of Fig. 7, as well as the cage 134 and upper seat 122 and upper flange features. The lower mushroom valve element 188 is identical to that of Fig. 7, as well as the lower flange 118, seat ring 124 and valve seat 126. A washer-like separation plate 226 is fixed midway along vertical axial support shaft 168 as by welding, separating upper coil spring 184 from lower coil spring 204. As shown, water is flowing upward through valve 220 to hydrant H and the water flow and coil spring pressure has forced upper mushroom valve 170 upward against cage seat 206. The knockoff of hydrant H and flange F results in the release of cage 134 and the sealing of upper mushroom valve 170 against seal 122 by upper coil spring 184 acting against separation plate 226, resulting in the stoppage of water flow out the valve.

The shutoff of water at hydrant H stops flow and allows lower coil spring 204 to act against separation plate 226, forcing lower mushroom valve 188 to seat against lower valve seat 126. Also, backpressure from the hydrant H initiating backflow through valve 220 results in the closing of lower

mushroom valve **188**, thereby preventing contamination of the water system.

Referring to Fig. 13, there is shown a section view of a variation on the embodiment of **valve 20** of Fig. 13, where no separation plate **226** is attached to axial support shaft **168** and a single coil spring **246** is employed between the engaging portion upper end **178** of upper mushroom valve **170** and the engaging portion lower end **198** of lower mushroom valve **188**. In this embodiment, during periods of no water flow the coil spring **246** forces upper mushroom valve **170** against cage seat **206** and lower mushroom valve **188** against valve seat **126**. This embodiment will operate as a stop flow valve upon loss of the hydrant **H**, and as a backflow check valve upon the development of water backpressure in the hydrant **H** or valve **220**.

The above-described embodiments of the invention are typically constructed of cast iron and steel, however, other suitable materials are contemplated in the construction of the various embodiments.

It is to be understood that the present invention is not limited to the embodiments described above, but encompasses any and all embodiments within the scope of the following claims.